ENERGY ENGINEERING ANALYSIS (EEA) PROGRAM

EUROPE

CARL SCHURZ KASERNE

NORDDEUTSCHLAND MILITARY COMMUNITY

VOLUME I: EXECUTIVE SUMMARY

FINAL SUBMISSION

SEPTEMBER 1983

DEPARTMENT OF THE ARMY
CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS
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VOLUME I - EXECUTIVE SUMMARY

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1.0 INTRODUCTION

This energy study of Carl Schurz Kaserne, Norddeutschland Community was authorized by the Department of the Army, Office of the Chief of Engineers as part of an Energy Engineering Analysis (EEA) Program. Overall program management rests with the Huntsville Division Corps of Engineers while contract management was performed by the Europe Division, headquartered in Frankfurt, West Germany.

This study is one of five EEA studies performed concurrently on five military communities, namely: Pirmasens; Zweibruecken; Norddeutschland; Baumholder; and Wiesbaden Military Communities. Carl Schurz Kaserne, located in Bremerhaven, is the only installation in Norddeutschland Military Community which was surveyed. The location of Carl Schurz Kaserne is shown on the vicinity map in Figure 1.1. The majority of the heated buildings in Carl Schurz Kaserne are maintenance facilities, barracks, warehouses and administration type buildings, all of which are OMA funded facilities. Heated buildings total 63 with a total gross square foot area of about 1,385,000. The majority of the buildings are of permanent masonry construction.

Utility systems primarily consist of heating plants and distribution systems, electrical supply and distribution systems, and water and sewage pump stations. In general, these systems were found to be in good condition. One central heating plant and a large number of individual heating plants are required for space heating and domestic hot water. The only fuel burned in the central plant and the one dozen individual heating plants is No. 2 fuel oil. Boilers were generally in good condition. The central plant has recently been improved with new burners and combustion controls. In general, the utility systems are in good condition, with the exception of the underground district heating network which is being replaced.

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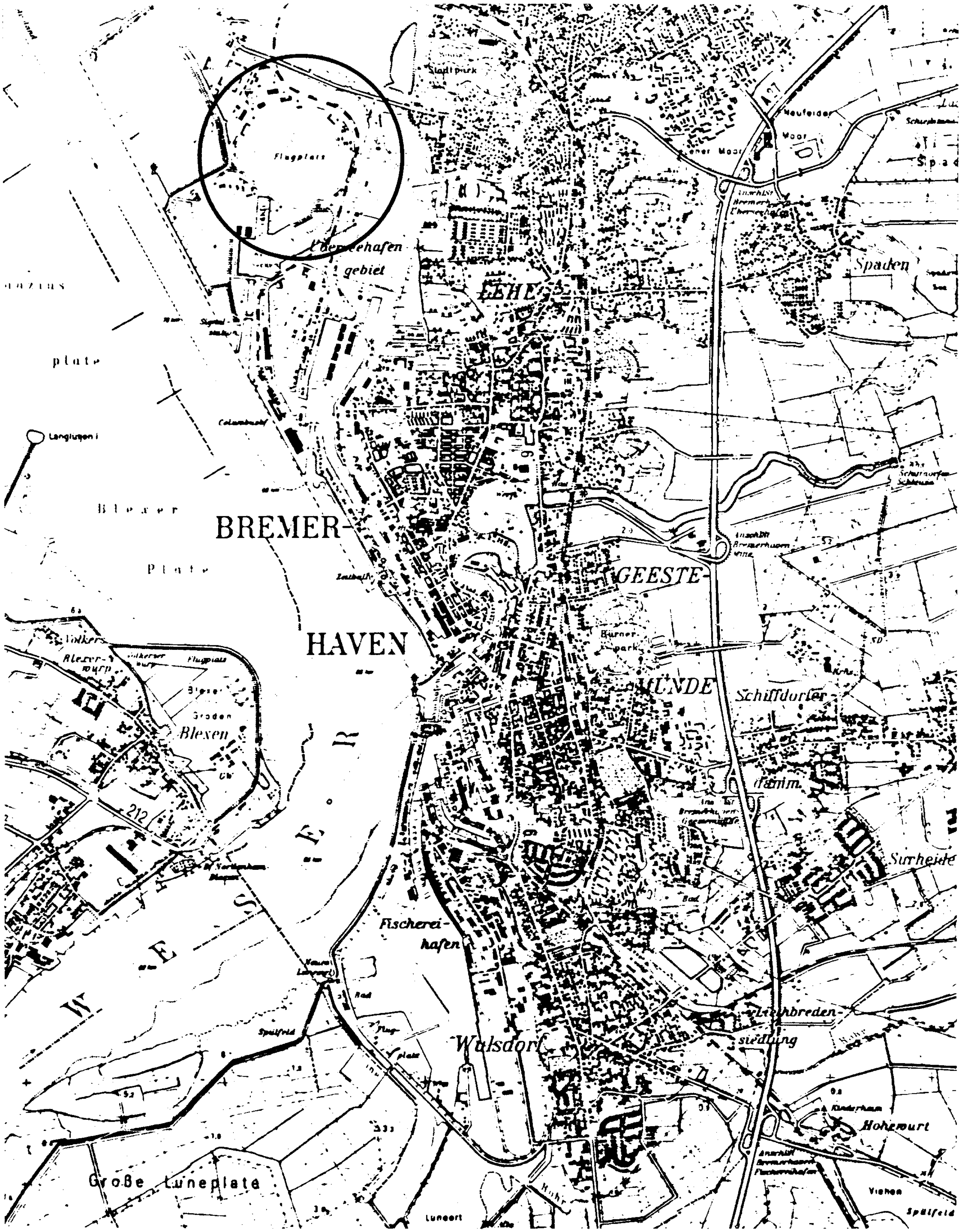
FIGURE I.1

NORDDEUTSCHLAND MILITARY COMMUNITY
CARL SCHURZ KASERNE



1.1 Objective

The objectives of this Energy Study, in accordance with the "Schedule of Title I Services for Energy Engineering Analysis Program, Europe", 13 December 1980, are as follows:

a. Develop a systematic plan of projects that will result in the reduction of energy consumption in compliance with the objectives set forth in the Army Facilities Energy Plan, without decreasing the readiness posture of the Army.

b. Use and incorporate applicable data and results of related studies, past and current as feasible.

c. Develop coordinated basewide energy plans for each military community.

d. Prepare Program Development Brochures (PDB), DD Forms 1391, and supporting documentation for recommended ECIP projects.

e. Include in the program studies all methods of energy conservation which are practical (insofar as the state-of-the-art is reasonably firm) and economically feasible in accordance with guidance given.

f. List and prioritize all recommended energy conservation projects.

The long term objective is to implement a policy of becoming as energy self-sufficient as the state-of-the-art for energy conservation will allow within our resources and economic bounds set by the full implementation of our national energy policy as prescribed by the Army Facilities Energy Plan (dated 1 Oct 1978). See Figure 6.4

The Energy Engineering Analysis (EEA) for Carl Schurz Kaserne includes Increments A, B, G and F of Title I Services, defined as follows:

Increment A: Energy Conservation Opportunities(ECO's) which fall under the Energy Conservation Investment Program (ECIP) for buildings and processes.

Increment B: ECIP projects for utilities, energy distribution, Energy Management Control Systems (EMCS) and the use of waste fuels.

Increment G: Operation, maintenance, repair and minor construction projects for energy conservation.

Increment F: Recommendations for modifications of facilities' system operations.

Data was collected on the design and condition of the physical facilities during detailed field surveys of representative buildings. Energy consumption characteristics were defined using information furnished by the community and by field measurement and data collection. A survey program, covering all buildings, was carried out to identify ECO's in the operation and maintenance of the utility systems.

Collected data was analyzed to identify the energy conservation opportunities, which fall into the above work increments, and to predict the savings which could result from repairs and improvements. A major part of the analyses focused on comparing theoretical energy requirements of the buildings with the reported energy consumption. The BLAST computer program was used to compute heat loads for buildings,

while a custom program was developed to combine the effects of energy conversion and distribution efficiency with the theoretical heat loads and known fuel consumptions. The latter program produced the fuel distribution report for each major heating system and characterized the loads.

The energy consumption characteristics of Carl Schurz Kaserne are typical of the installations throughout West Germany which provide a complete working and living environment for military personnel. In contrast to many military facilities in the United States, there is no air conditioning for comfort cooling. Energy loads can be broadly classified into several groups as follows:

Thermal

- space heating
- domestic hot water
- process

Electrical

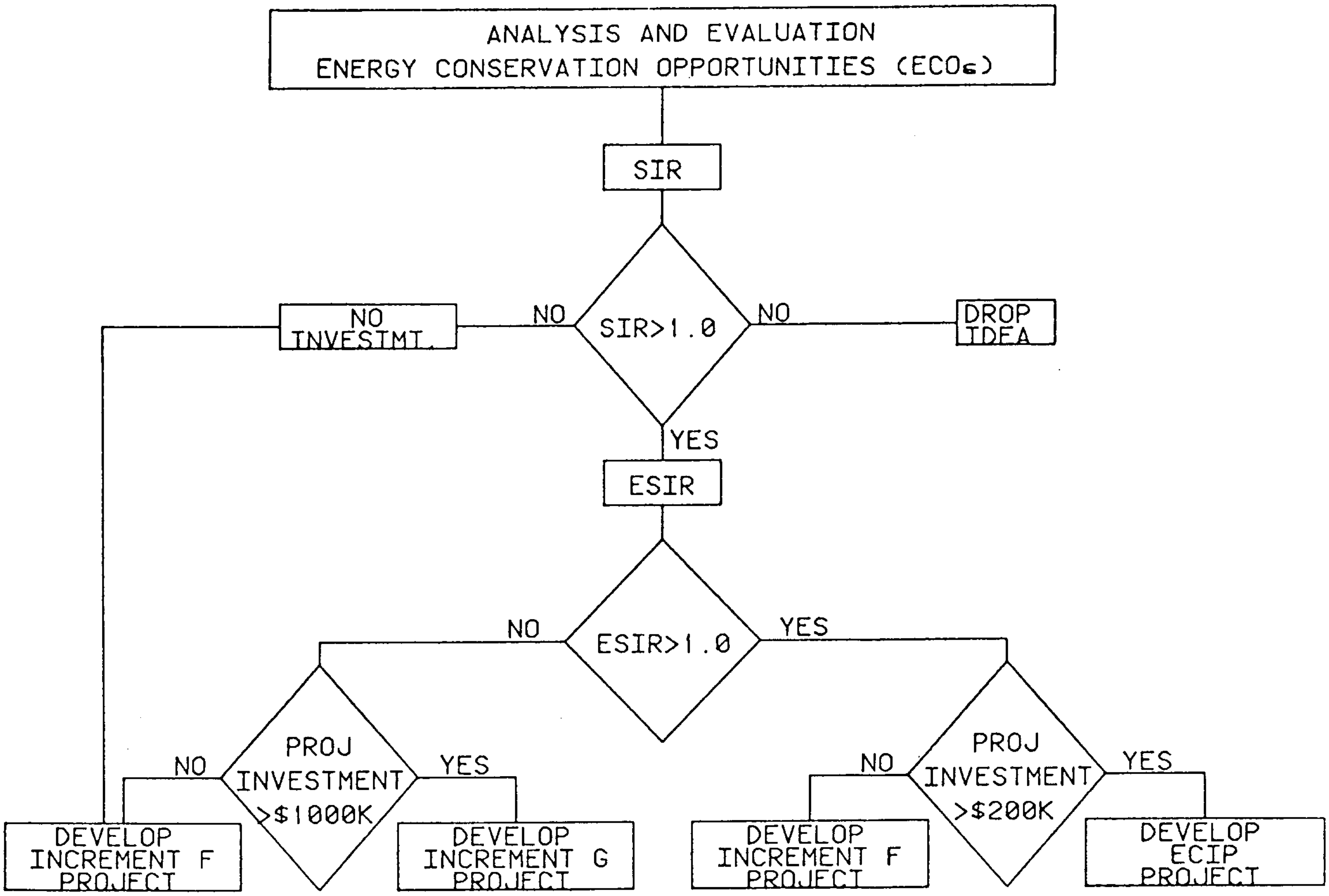
- lighting
- domestic appliances
- clothes dryers
- utility system motors
- shop and store equipment

Thermal and electrical loads at Carl Schurz Kaserne peak in mid-winter and are lowest in mid-summer, as expected. Electrical loads peak during normal work day hours and follow typical patterns for a commercial type community in a Northern climate. Weekend electrical load peaks are much smaller than weekday peaks, indicating that work areas are effectively shut down on weekends.

Based on the physical facilities and the energy load characteristics, ECO's were developed and analyzed for feasibility in accordance with FY 85 ECIP Guidance. Figure 1.2 shows the Project Flow Diagram indicating the economic analysis of an ECO. A systematic approach considering primary energy conversion, energy distribution, and energy utilization was employed to assure that the opportunities for energy savings would be identified. Special attention was given to state-of-the-art energy technology for conservation, management, and alternatives to the use of fossil fuels.

In cooperation with the Community, the A/E developed ECIP programming packages based upon study recommendations. DD Forms 1391 were prepared and submitted to the Community on 13 June 1983 for approval.

Detailed field survey data which served as the basis of the energy engineering analysis was previously submitted to the Norddeutschland Military Community in a series of data report volumes. The contents of the interim submission, Volume I and II for increments A, B, and G, and the contents of the preliminary submission for increment F are combined and updated in this report.



NOTES: 1. SAVINGS TO INVESTMENT RATIO (SIR) CALCULATED AS PER NEW ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) GUIDANCE.
2. CALCULATE ENERGY SAVINGS TO INVESTMENT RATIO (ESIR) USING THE LOWER NUMBER:
(ENERGY $ SAVINGS + 0.33 ENERGY $ SAVINGS)/INVEST
(ENERGY $ SAVINGS + 0.33 ENERGY $ SAVINGS)/INVEST

2.0 EXISTING ENERGY CONSUMPTION

Energy consumption in FY 1975 is the baseline against which the reduction of energy consumption is measured. FY 1980 energy consumption data was used as a reference year for the EEA study. Energy consumption data for Carl Schurz Kaserne for both these years is shown in Table 2.1. This data was provided by the Installation and includes the same energy consumers as the EEA study.

To characterize the fuel consumption of Carl Schurz Kaserne, data for three fiscal years is compared. Figure 2.2 shows the fuel consumption profile for FY 78, FY 79 and FY 80. Figure 2.3 shows the total electrical consumption of Carl Schurz Kaserne; this is broken down to on-peak and off-peak consumption relating to the utility's time-of-day rates. On-peak consumption ranges from approximately 340,000 kWh to 480,000 kWh per month and off-peak ranges from approximately 100,000 kWh to 160,000 kWh per month. Figure 2.4 shows the annual demand profile for Carl Schurz Kaserne and Figure 2.5 shows the typical day load profile. Figure 2.6 shows the proportion of energy consumed by type of load.

The BLAST program was used to characterize the energy consumption of individual buildings. Annual fuel consumption profiles for specific buildings with typical functions and design day load profiles for representative types of buildings in Carl Schurz Kaserne are presented in Section 3, Volume II: Figures 2.7 and 2.8 are typical. The building type indicated on the design day load profile is the classification used in the Fuel Distribution Program (FDP) previously mentioned. Estimated distribution of the fuel consumption by building and load type is shown in Figures 2.9 through 2.10.

TABLE 2.1

BASELINE AND REFERENCE ENERGY CONSUMPTION DATA

(Based on 1.385×10^6 SF Area)

	FY 1975	FY 1980	
Fuel Type	Consumption (MBTU/yr)*	$/MBTU	Consumption (MBTU/yr)*
Heating Oil No. 2	123,020	8.80	143,723
Electric**	69,554	5.85	74,449
TOTAL (MBTU)	192,574		218,172
KBTU/sq.ft./yr	139.04		157.5

*MBTU = 10E6 BTU

**11,600 BTU/kWh

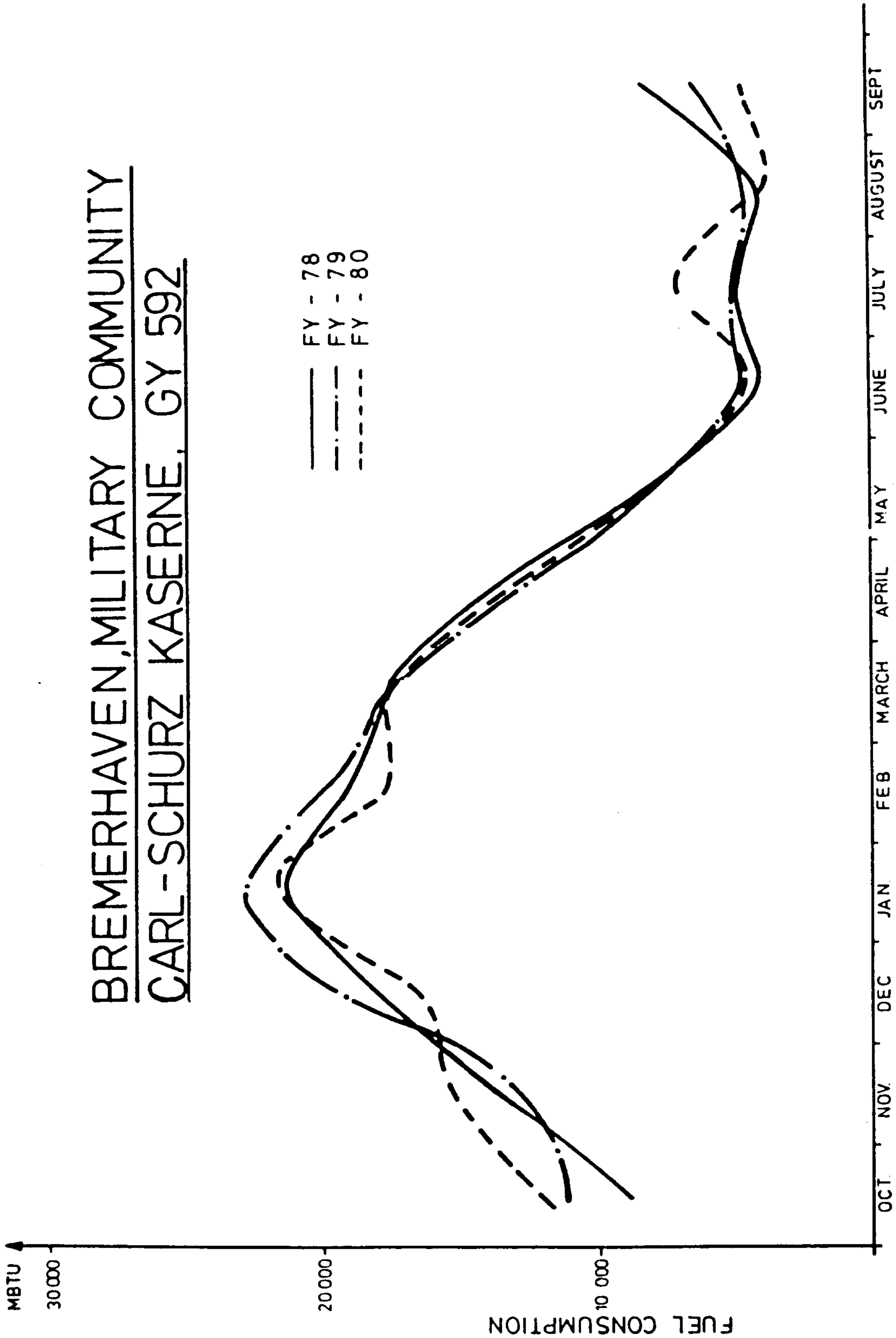
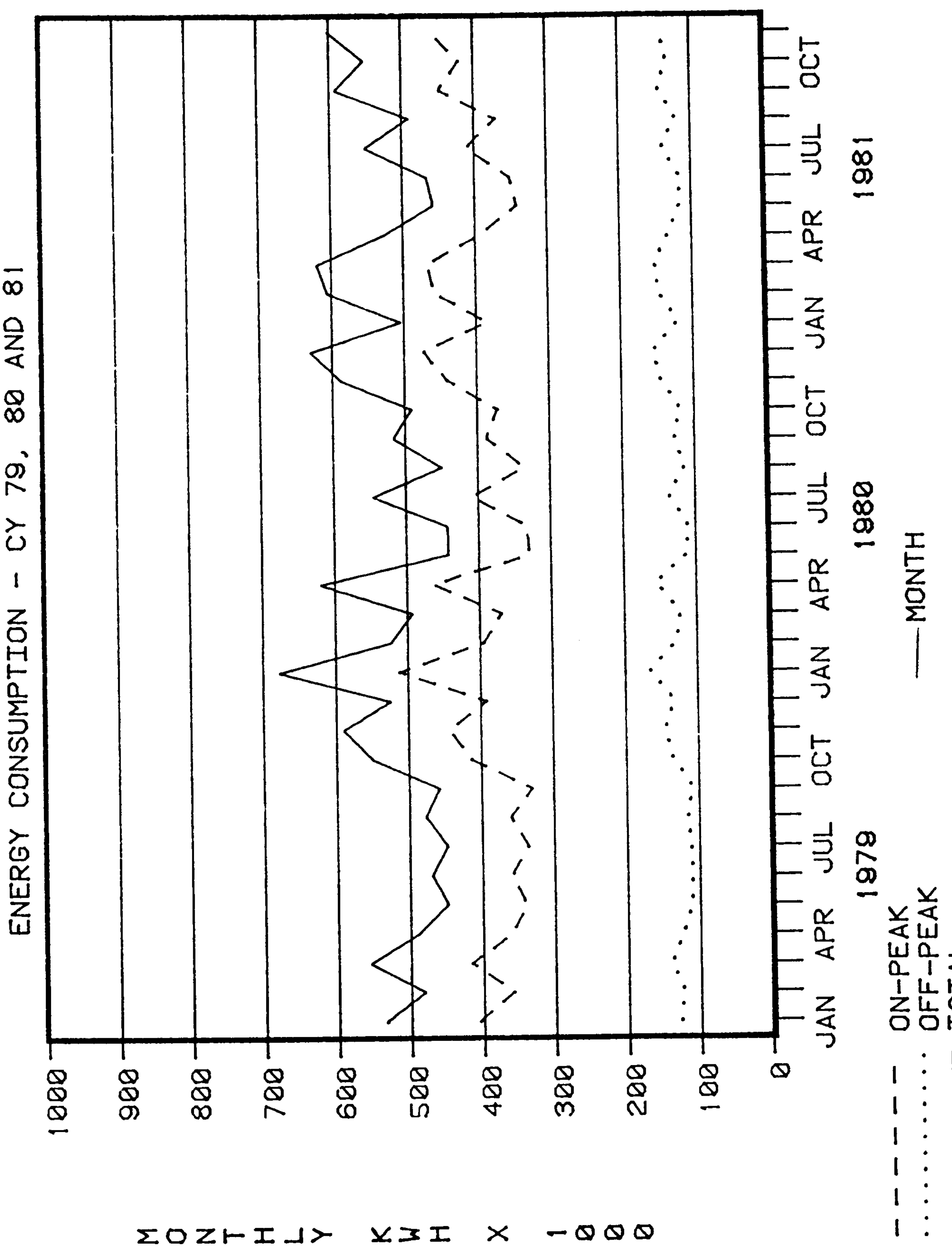

BREMERHAVEN,MILITARY COMMUNITY
CARL-SCHURZ KASERNE, GY 592
FY - 78
FY - 79
FY - 80
MBTU
30 000
20 000
10 000
FUEL CONSUMPTION
OCT.
NOV.
DEC
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPT

FIGURE 2.2



ENERGY CONSUMPTION - CY 79, 80 AND 81
MONTHLY KWH X 1000
1000
900
800
700
600
500
400
300
200
100
0
JAN APR JUL OCT JAN APR JUL OCT JAN APR JUL OCT
1979
1980
1981
MONTH
ON-PEAK
OFF-PEAK
TOTAL

FIGURE 2.3

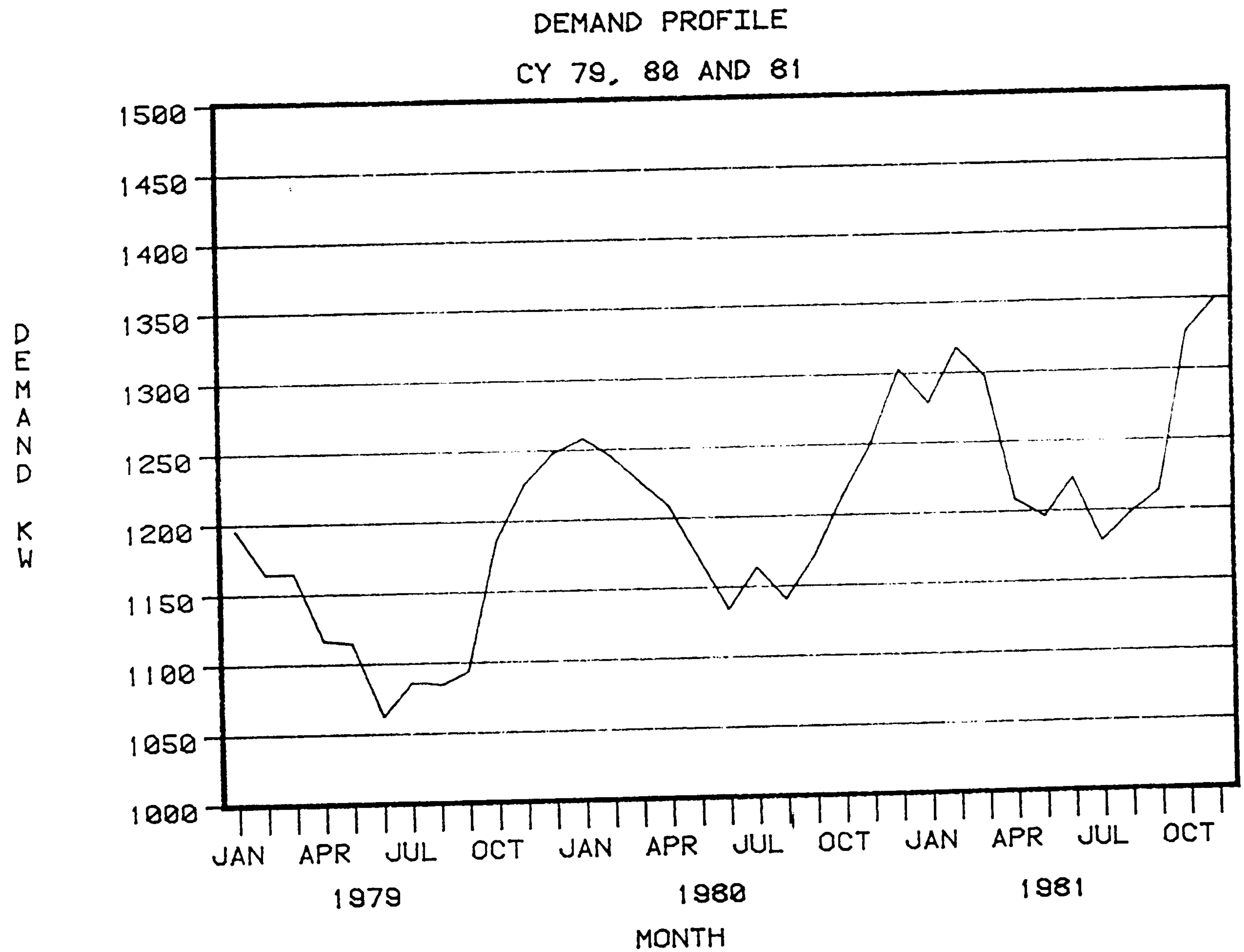

DEMAND PROFILE
CY 79, 80 AND 81
DEMAND KW
1500
1450
1400
1350
1300
1250
1200
1150
1100
1050
1000
JAN
APR
JUL
OCT
JAN
APR
JUL
OCT
JAN
APR
JUL
OCT
1979
1980
1981
MONTH

FIGURE 2.4

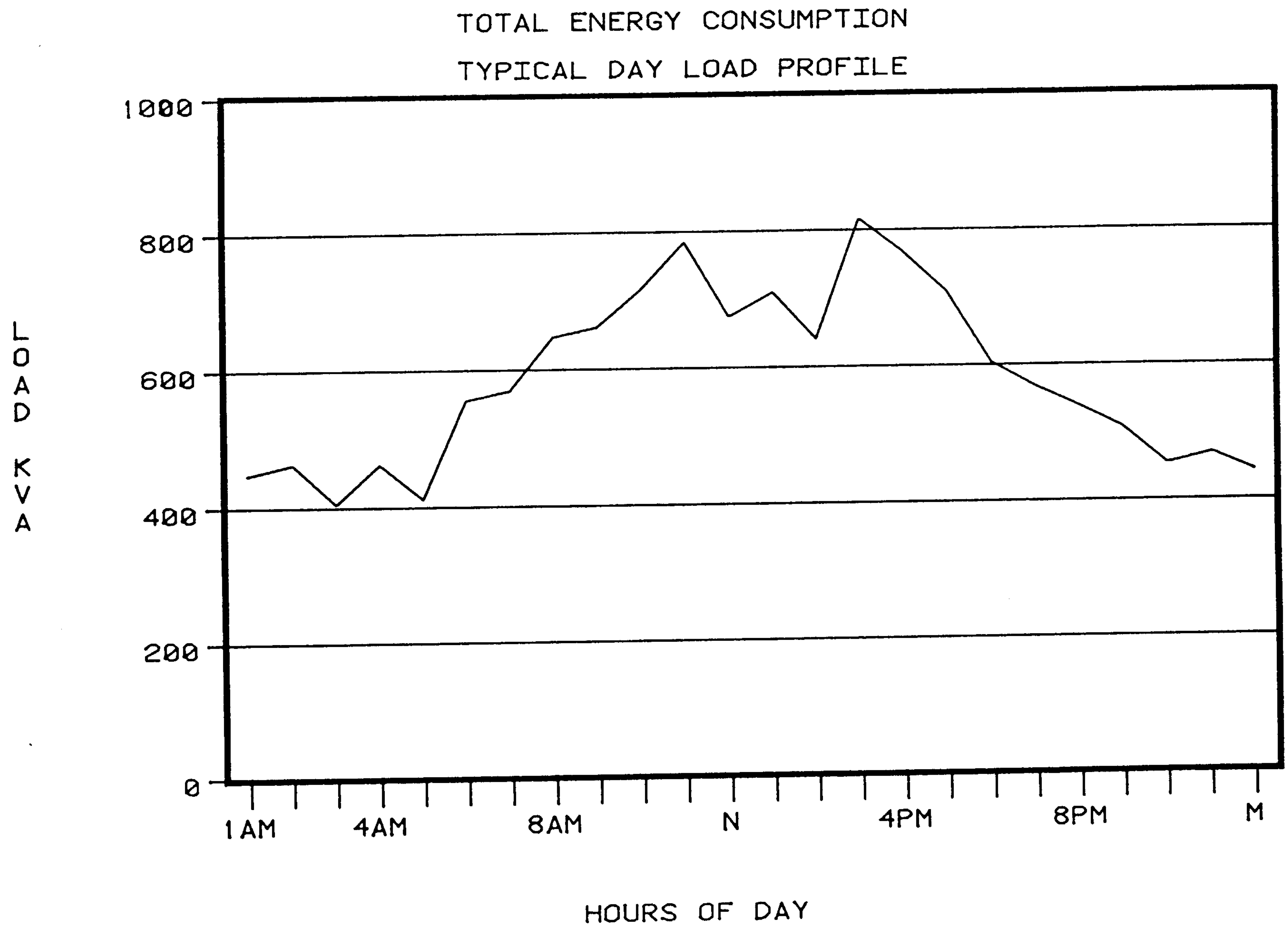

TOTAL ENERGY CONSUMPTION
TYPICAL DAY LOAD PROFILE
LOAD KVA
1000
800
600
400
200
0
1AM
4AM
8AM
N
4PM
8PM
M
HOURS OF DAY

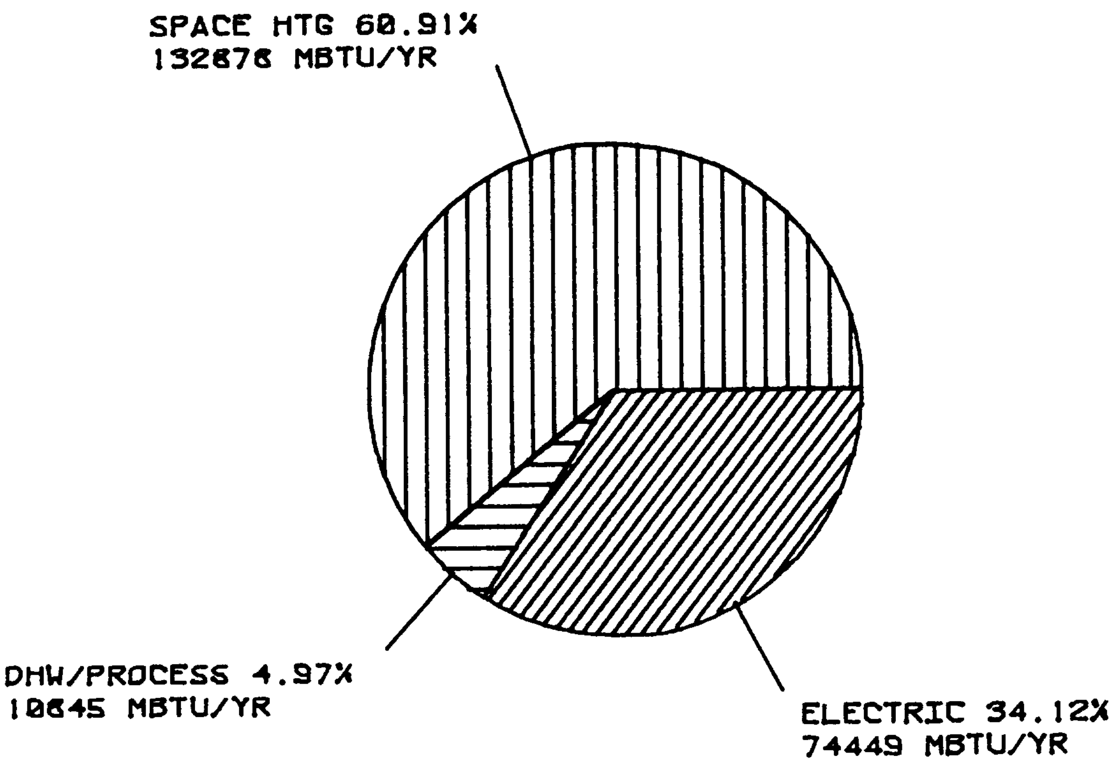
FIGURE 2.5

FIGURE 2.6

TOTAL ENERGY CONSUMPTION (FY 1980)

NORDDEUTSCHLAND MILITARY COMMUNITY

CARL SCHURZ KASERNE



TOTAL ENERGY CONSUMPTION - 218,172 MBTU/YR
(143723 MBTU/YR #2 OIL; 74,449 MBTU/YR ELECTRIC)

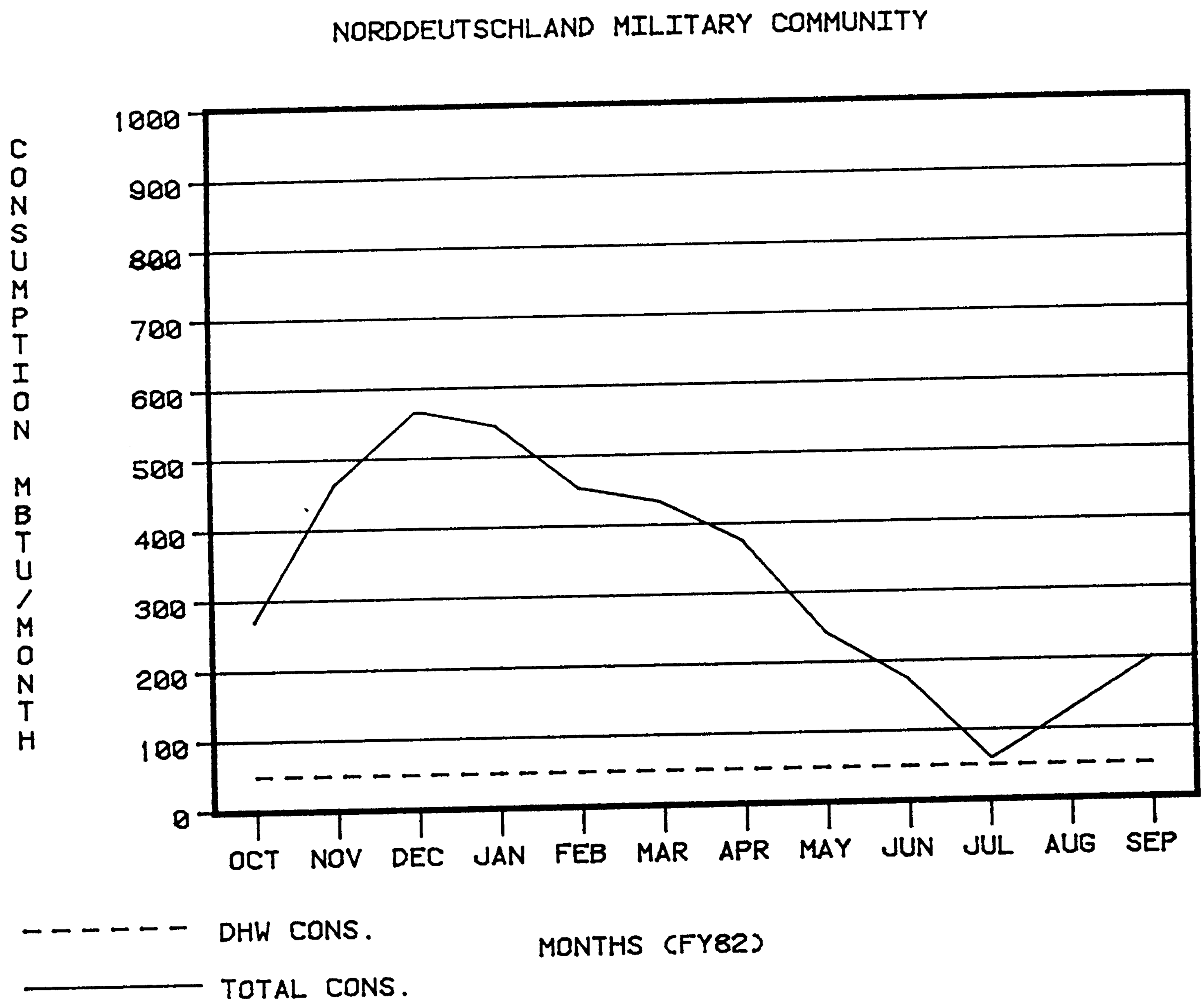
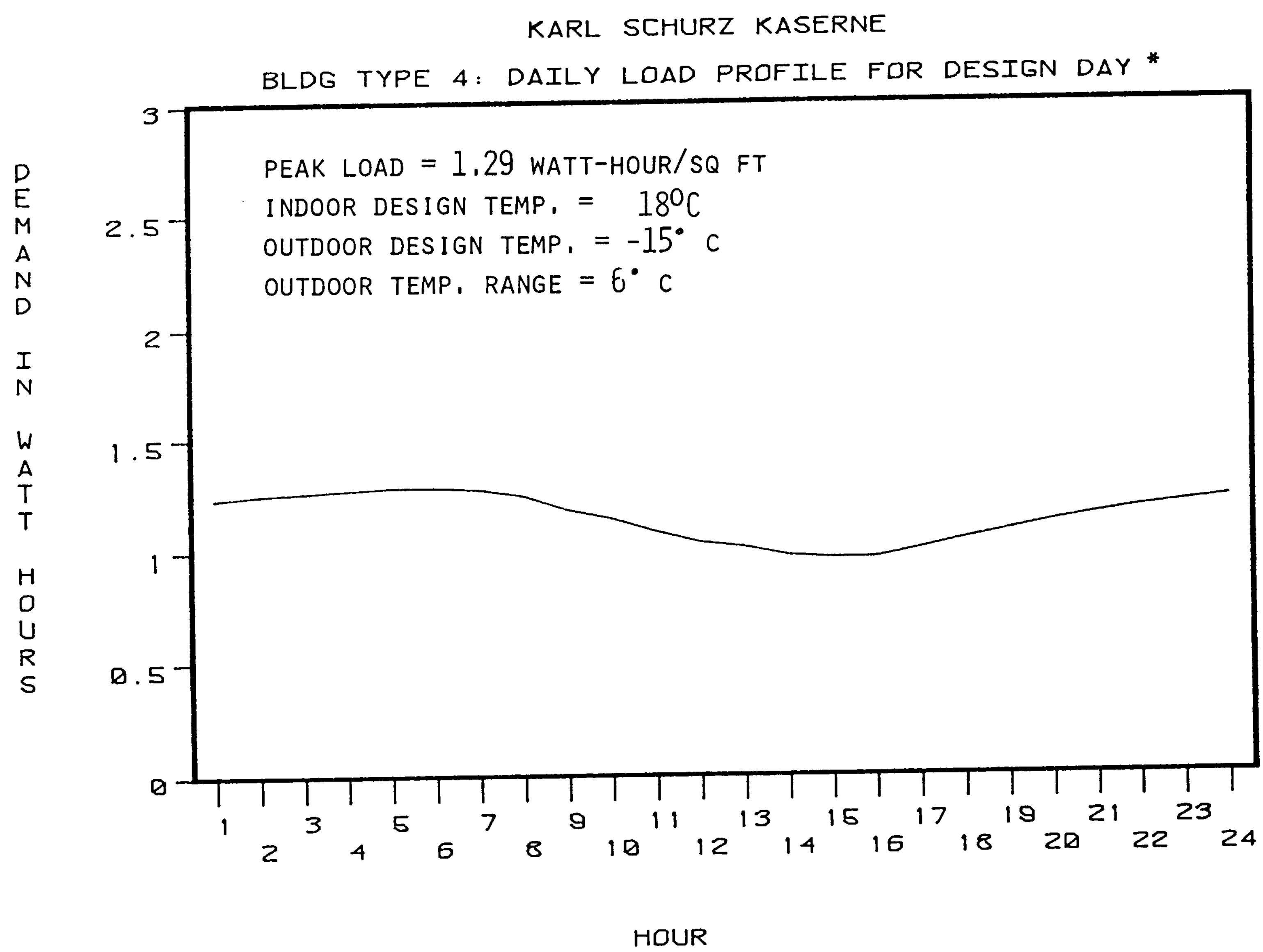


FIGURE 2.7: Annual Fuel Consumption Profile
for Barracks Bldg. #10



* LOAD PROFILE CALCULATED BY "BLAST"

FIGURE 2.8: Design Day Load Profile for Barracks Type Building

FIGURE 2.9

NORDDEUTSCHLAND MILITARY COMMUNITY

BLAST WEIGHTING FACTORS

FUEL DISTRIBUTION

UNITS: AREA = SQUARE FEET, FUEL CONSUMPTION = MBTU/YR, LOAD = MBTU/YR

HEAT PLNT	BLDG SERV	BLDG FUNC	BLDG TYPE	TOTAL AREA	NET AREA	HEAT SYST	FUEL TYPE	FUEL CONS	EFF	SPEC LOAD	DHW LOAD	SPACE LOAD
110												
	1	ADMNSTRTN	6	32428	25942	LTW	OIL2	2936	0.68	0	0	1997
	2	ADMNSTRTN	6	86018	48384	LTW	OIL2	5477	0.68	0	0	3724
	3	ADMNSTRTN	5	7530	6024	LTW	OIL2	824	0.68	0	0	560
	6	BARRACKS	4	29224	24465	LTW	OIL2	3591	0.68	0	415	2027
	7	BARRACKS	4	64792	33251	LTW	OIL2	4881	0.68	0	564	2755
	8	BARRACKS	4	64557	31926	LTW	OIL2	4687	0.68	0	542	2645
	9	BARRACKS	4	46748	24065	LTW	OIL2	3533	0.68	0	408	1994
	10	BARRACKS	4	49021	24142	LTW	OIL2	3544	0.68	0	410	2000
	11	BARRACKS	4	57890	29807	LTW	OIL2	4376	0.68	0	506	2470
	12	ADMNSTRTN	6	49232	39386	LPS	OIL2	4458	0.68	0	0	3032
	13	BARRACKS	4	47124	23105	LTW	OIL2	3392	0.68	0	392	1914
	15	ADMNSTRTN	5	2587	2070	LPS	OIL2	283	0.68	0	0	192
	88	MAINT SHOP	11	2368	2013	LPS	OIL2	366	0.68	0	2	246
	89	REPAIR SHOP	12	17214	14692	HPS	OIL2	3458	0.68	0	0	2352
	100	COMMISSARY	4	3062	2603	LTW	OIL2	382	0.68	0	44	216
	101	[illegible] PRO CTR	12	15191	12912	LPS	OIL2	3070	0.68	0	21	2067
	102	WAREHOUSE	11	66823	56800	LPS	OIL2	10224	0.68	0	0	6952
	103	GYM/WRHS	7	99926	77942	LTW	OIL2	21122	0.68	0	447	10916
	104	MAINT SHOP	11	71672	60921	LPS	OIL2	11076	0.68	0	75	7457
	105	CMMNTY CNTR	4	48640	41351	LPS	OIL2	6070	0.68	0	702	3426
	106	ADMNSTRTN	5	12568	10054	LTW	OIL2	1375	0.68	0	0	935
	107	COMMISSARY	4	36401	30941	LTW	OIL2	4542	0.68	0	525	2564
	108	BARRACKS	4	16140	13719	LTW	OIL2	2014	0.68	0	233	1137
	109	CMMNTY CNTR	7	9247	7213	LTW	OIL2	1486	0.68	0	0	1010
	110	CNTRL HEAT	14	23577	0	N/A	OIL2	0	0.74	0	0	0
	113	MAINT SHOP	11	9397	7987	LPS	OIL2	1452	0.68	0	10	978
	128	MAINT SHOP	11	13995	11896	LPS	OIL2	2163	0.68	0	15	1456
	131	CHAPEL	6	5888	4710	LTW	OIL2	839	0.68	0	0	570
	205	MESSHALL	7	6786	5293	LTW	OIL2	1807	0.68	0	488	741
	206	MESSHALL	7	6786	5293	LTW	OIL2	1807	0.68	0	488	741
	226	ADMNSTRTN	6	29371	23497	LTW	OIL2	2660	0.68	0	0	1809
	227	ADMNSTRTN	6	28723	22978	LTW	OIL2	2601	0.68	0	0	1769
	228	ADMNSTRTN	6	29371	22978	LTW	OIL2	2601	0.68	0	0	1769
	229	ADMNSTRTN	6	29042	23234	LTW	OIL2	2630	0.68	0	0	1788
	230	ADMNSTRTN	6	28723	22978	LTW	OIL2	2601	0.68	0	0	1769
	251	ADMNSTRTN	6	28723	22978	LTW	OIL2	2601	0.68	0	0	1769
	253	COMMISSARY	4	35419	30106	LTW	OIL2	4420	0.68	0	511	2494
	267	GEN PURP	8	1836	1450	LTW	OIL2	235	0.68	0	0	160
111												
	111	PUMP STN	11	1672	1321	LTW	OIL2	226	0.67	0	0	151
	112	PUMP STN	11	1816	1435	LTW	OIL2	274	0.60	0	0	164
134												
	134	MAINT SHOP	11	5340	4539	LTW	OIL2	824	0.71	0	6	579

FIGURE 2.10

136	136	MAINT SHOP	11	5340	4539	LTW	OIL2	824	0.71	0	6	579
158	158	MESSHALL	7	2406	1877	LPS	OIL2	682	0.73	0	154	344
160	160	BARRACKS	7	4200	3063	LTW	OIL2	856	0.71	0	146	462
161	161	BARRACKS	7	4200	3063	LTW	OIL2	856	0.71	0	146	462
162	162	BARRACKS	7	4200	3063	LTW	OIL2	856	0.69	0	0	591
163	163	SHOWER/WASH	8	1636	1292	LPS	OIL2	329	0.80	77	0	186
168	168	CMMNTY CNTR	9	5479	4328	LTW	OIL2	704	0.71	0	75	425
169	169	WAREHOUSE	11	4200	3570	LPS	OIL2	648	0.71	0	5	455
170	170	MAINT SHOP	11	4468	3798	LTW	OIL2	690	0.71	0	5	485
172	172	WAREHOUSE	11	2406	2045	LTW	OIL2	371	0.71	0	3	261
295	295	TRNSMTR STN	12	2915	2478	AIR	ELEC	622	1.00	0	0	622
296	296	TRNSMTR STN	12	3055	2597	AIR	ELEC	652	1.00	0	0	652

UNHEATED BUILDINGS

BUILDING NUMBER	BUILDING FUNCTION
4	BEING RENOVATED
17	DISTRIBUTION STATION
30	TRANSFORMER STATION
31	TRANSFORMER STATION
32	DISTRIBUTION STATION
54	TRANSFORMER STATION
119	TRANSFORMER STATION
126	TRANSFORMER STATION
130	TRANSFORMER STATION
191	TRANSFORMER STATION
297	TRANSFORMER STATION

3.0 ENERGY CONSERVATION OPPORTUNITIES DEVELOPED

As described under the Methodology Section, Volume II: Study Report, based upon record data provided by the community, detailed site surveys and discussions with Facilities Engineering personnel, all practical energy conservation measures were technically and economically evaluated to determine if they met ECIP criteria. The "Energy Conservation Options" listing for Climate Zone 3 (3000 - 6000 degree days) in Annex E of the Army Facilities Energy Plan was used as a starting list of possible conservation measures; this list, modified to be applicable to installations in West Germany, is presented in Section 4, Volume IV: Appendix. Recommended modifications which were not on the list include the installation of fans to prevent hot air stratification, installation of thermal barriers for windows in intermittently occupied buildings, installation of domestic hot water heat pumps and installation of turbulators in firetube boilers.

Based upon recommendations made by the A/E in the Interim Submittal and agreements reached with the community, recommended ECIP projects were packaged and project documents developed for ECIP funding in accordance with FY 85 criteria. Those energy conservation measures are described hereafter; ECO numbers and titles correspond to those presented in Section 4 of Volume II.

ECO No. 41111: Weatherstripping

Infiltration of outside cold air through openings and gaps in the building shell can account for up to 25% of the total annual space heating fuel consumption. Weatherstripping is a cost effective way of significantly reducing infiltration through windows and doors which currently have no weatherstripping.

ECO No. 41121: Roof Insulation

Heat load analysis leads to the recommendation of roof insulation for many buildings. Building roofs generally have higher heat loss and lower insulation cost per square foot than walls. The best type of insulation is determined by the configuration and the utilization of the attic space.

ECO No. 41131: Wall Insulation

Heat load analysis leads to the recommendation of wall insulation for many buildings. Generally, wall insulation can be placed on the exterior surface or interior surface. The application to the exterior of outside walls is preferable in order to maintain normal operation of the building and to enable the optimization of the surface absorption coefficient.

ECO No. 41141: Double Glazed Windows

A significant portion of energy loss through a building envelope is due to windows. Heat Losses occur due to both conduction of heat through the glass and infiltration of outside air through window perimeter cracks. Where infiltration heat losses are excessive due to poor fitting windows, new double glazed tight fitting windows are recommended. Although weatherstripping can also reduce infiltration through windows, the life of the weatherstripping is very limited compared to carefully installed windows.

ECO No. 41211: Lighting System Replacement

The development of high efficiency lighting systems created opportunities for reducing the energy for lighting without reducing the illumination. In many lighting systems this can be accomplished by simply replacing the lamp. Slight modifications to existing fixtures are required for some conversions to high efficiency lamps.

ECO No. 42111: Thermostatic Radiator Valves

Thermostatic radiator valves regulate indoor temperature by controlling the heating fluid supply to radiators. Thermostatic radiator valves reduce localized overheating by compensating for interior and exterior heat gains other than the heating system and limit the maximum heat supply to a radiator.

ECO No. 42112: Building LTW Controls

Building temperature control systems are installed to adjust the heating water supply temperature to the radiators in a building. Overheating of buildings is reduced by regulating the supply temperature in response to weather conditions, and by improving heat distribution where buildings are part of a network.

ECO No. 42113: Building LPS Controls

Building heating system controls are installed to regulate the steam supply to the building terminal units in response to outdoor temperature. Overheating of buildings is thus reduced and steam pressure may be lowered to reduce distribution losses.

ECO No. 42121: Prevent Air Stratification

In large open areas with high ceilings, warm air rises creating a temperature differential between the floor and ceiling. If room air is vertically mixed, such as by ceiling fans, the air temperature stratification is reduced. A more uniform temperature results in less heat to maintain minimum temperature at the occupied floor level and less heat loss through the roof.

The following project was developed, even though it does not meet ECIP criteria, because it will serve to reduce Carl Schurz Kaserne dependence on critical fuels; however it will also increase the total installation fuel consumption. The Savings-to-Investment Ratio is greater than 1.0 but the Energy Savings-to-Investment Ratio is less than 1.0.

ECO No. 43133: Conversion of Oil Fired Central Heating Plant to Automatic Coal Firing

Central Heating Plant 110 currently uses no. 2 fuel oil and operates at a higher efficiency than a new automatic coal fired central plant would; this is primarily due to recently installed combustion controls. A conversion to automatic coal firing would substantially reduce operating costs making the project economically attractive; however, the total annual fuel consumption (MBTU/yr) would increase marginally.

Specific Operations and Maintenance Modifications were identified as follows:

- Load Shedding
- Repair Vent Dampers and Seal Miscellaneous Openings in Building Envelopes
- Reset Existing Heating System Controls
- Reduce Domestic Hot Water Temperature
- Replace Damaged Leaking Radiator Valves, Reset Thermostatic Valves
- Repair or Add Thermostats to Reduce Overheating
- Disconnect Electric Water Coolers
- Reduce Heating in Unoccupied Areas
- Installation of Timers on Vending Machines
- Reduction of Lighting by Lamp Removal
- Add Light Switches
- Add Timers to Light Switches
- Add Outdoor Light Controls

General Operations and Maintenance Recommendations were made as follows:

- Night Temperature Setback
- Domestic Hot Water Flow Control
- Relamp Incandescent Fixtures
- Optimize Transformer Loading

In addition to the above listed projects, developed to improve the efficiency of energy conversion, distribution and utilization, policy changes are recommended which can reduce energy consumption and/or operating costs:

- Improve communications between the users and the office of the facility engineer by means of an energy conservation coordinator of each installation and a monitor for each energy consuming building. The energy usage for each building should be recorded and discussed at regular meetings where policy for energy conservation performance can be evaluated.

- Educate the building occupants to minimize the use of lighting, domestic hot water and heat. All family housing lighting and some hot water heaters in individual dwelling units are controlled by building occupants. Although building controls and thermostatic valves can reduce overheating, windows and doors left open in the heating season cannot be eliminated by controls.

- Negotiate for reducing the cost of purchased electricity. Since utility rates are designed for an entire class of customers, a fair but more attractive rate may be considered negotiable for a specific load profile. Investigate the consolidation of electrical services which are billed under different rate schedules to achieve a more favorable rate structure.

- o Institute procedures to assure that energy savings are considered in all new projects which are specified. When specific goals and guidelines are adopted, the facilities should be upgraded in a uniform manner with each repair or new construction project. All projects should be reviewed by the community energy coordinator to assure that these projects are consistent with energy plan goals.

- o Specify energy conservation options for replacement equipment as follows:

  - high efficiency motors
  - high efficiency air conditioning units
  - automatic shut off controls for clothes dryers
  - improved insulation and other design features for domestic food refrigerators

- o Institute procedures to monitor effectiveness of energy conservation modifications.

- o Institute procedures for the maintenance and fine tuning of energy conservation equipment in order to maintain the same level of energy savings throughout the life of the equipment.

4.0 ENERGY AND COST SAVINGS

Basewide energy consumption after implementation of the EEAP Energy Plan is projected to be 151,621 MBTU/yr; this is a 21.5% reduction in fuel consumption as compared to FY 75 energy consumption of 192,574 MBTU/yr.

The projected savings are allocated by fuel type as follows:

	ANNUAL CONSUMPTION (MBTU/yr)			SAVINGS
	FY 75	FY 80	FY 86	MBTU/YR
Electric :	69,554	74,449	71,785	- 2,231
No. 2 Oil :	123,020	143,723	79,836	43,184
			TOTAL SAVINGS =	40,953

In constant FY 80 dollars, the cost of Carl Schurz Kaserne's energy is projected to be $1,122,499 as compared to $1,489,467 : a savings of $366,968 per year in 1980 dollars.

4.1 ECIP Projects

Project documents have been prepared for energy conservation measures which qualify for ECIP funding. Volume III of the report contains completed DD Forms 1391 and Project Development Brochures for these projects. ECIP projects are summarized in Table 4.1.

The implementation of the energy conservation measures developed for ECIP funding will require an investment of $1,162,700 and result in an annual savings of 41,081 MBTU/yr. Assuming a discount rate of 10%, the discounted payback for the total investment would be 2.3 years.

TABLE 4.1

SUMMARY OF RECOMMENDED ECIP PROJECTS

PROJECT DESCRIPTION	ENERGY SAVED (MBTU/YR)	ENERGY SAVED ($/YR)	TOTAL INVESTMENT ($000)	ESIR
ECIP WEATHERIZATION (OMA Facilities)	30,853	270,342	839.5	3.7
o Install Weatherstripping				
o Install Roof Insulation				
o Install Wall Insulation				
o Install Double Glazed Windows				
ECIP ENERGY CONSERVATION IMPROVEMENTS (OMA Facilities)	10,228	87,591	323.2	3.11
o Install Mess Hall Exhaust Air Heat Recovery				
o Install Thermostatic Radiator Valves				
o Install Building LTW Controls				
o Install Building LPS Controls				
o Prevent Air Stratification				
o Lighting System Replacement				
	41,081	357,933	1,162.7	

4.2 Specific Operation and Maintenance Modifications

Recommendations for modification of the operation and maintenance of utility systems were developed from building operations survey data as a part of Increment F. These energy conservation measures are expected to save 3,583 MBTU/yr for a total investment of $7,453: at an estimated savings of $30,235/yr the investment will payback in less than 3 months. Specific recommendations are summarized in Table 4.2.

4.3 General Operation and Maintenance Modifications

General opportunities for conservation in the operation and maintenance of utilities systems which have been recommended are summarized below:

PROJECT DESCRIPTION	ENERGY SAVINGS (MBTU/yr)	MATERIAL COST ($)	LABOR HOURS (Hours)
<u>Night Temperature Setback</u> The energy savings attainable through night and weekend temperature setback of intermittently occupied buildings was not applied to the ECIP projects for building heating system controls. After the controls are installed, setback of indoor temperature during unoccupied periods can be implemented for additional heating energy savings.	19,293	-	48
<u>Domestic Hot Water Flow Control</u> Where flow rates through shower heads and faucets are excessive, flow control devices are being installed to limit energy consumption.	1,467	1,100	48

TABLE 4.2

INCREMENT F:

SUMMARY OF OPERATION AND MAINTENANCE MODIFICATIONS

BLDG	CONSERVATION OPTION	MBTU/YR	$/YR	TOTAL COST	ESIR	SIR	MANHOURS	L.T.	REF.
0011	Reduce DHW Temperature	190	1,668	12	1,723.9	1,723.9	1	1	04
0158	Reduce DHW Temperature	47	415	12	429.1	429.1	1	1	04
0102	Reduce DHW Temperature	73	428	12	428.5	428.5	1	1	36
0004	Reduce DHW Temperature	43	375	12	387.9	387.9	1	1	04
0160	Reduce DHW Temperature	32	280	12	289.7	289.7	1	1	04
0170	Install Thermostat	268	2,357	105	283.9	283.9	4	2	11
0015	Reset Thermo Rad. Valves	120	1,056	49	272.9	272.9	4	1	08
0169	Install Thermostat	252	2,215	105	266.8	266.8	4	2	11
0250	Disconn. 2 Water Coolers	41	238	11	266.2	266.2	1	2	32
0168	Install Thermostat	235	2,064	105	248.6	248.6	4	2	11
0205	Reset Heat Controls	101	885	49	228.7	228.7	4	1	02
0206	Reset Heat Controls	101	885	49	228.7	228.7	4	1	02
0008	Stop Heat Unoccupied Area	809	7,117	440	204.4	204.4	12	1	10
0007	Stop Heating Of Loft	705	6,202	440	178.1	178.1	12	1	10
0128	Reduce DHW Temperature	8	66	12	68.5	68.5	1	1	04
0105	Delamp Upper Hall	19	113	22	63.2	63.2	2	2	38
0113	Reduce DHW Temperature	6	56	12	57.5	57.5	1	1	04
0101	Reduce DHW Temperature	14	122	49	31.6	31.6	4	1	04
0108	Reduce Heat Unocc. Space	184	1,623	781	26.2	26.2	24	1	10
0253	Add Storage Lt. Switches	46	272	210	15.9	15.9	8	2	39
0009	Delamp Halls	26	149	131	13.9	13.9	12	2	38
0089	Replace Vent Damper	12	106	110	12.2	12.2	4	1	01
0103	Repair Vent Damper	12	106	110	12.2	12.2	4	1	01
0007	Delamp Basement	7	43	44	12.2	12.2	4	2	38
0011	Delamp Halls	30	177	195	11.1	11.1	16	1	38
0010	Delamp Halls	13	76	87	10.6	10.6	8	2	38
0006	Basement Light Timer	6	34	46	9.0	9.0	2	2	40
0007	Basement Light Timer	6	34	46	9.0	9.0	2	2	40
0006	Bath Vent Fan Timer	12	68	105	7.9	7.9	4	2	40
0009	Hall Light Timers	30	177	278	7.8	7.8	12	2	40
0006	Delamp Basement	9	54	87	7.6	7.6	8	2	38
0008	Delamp Basement	5	27	44	7.6	7.6	4	2	38
0226	Stair Light Timers	4	24	46	6.5	6.5	2	2	40
0250	Timer On Vending Machine	9	51	105	5.9	5.9	4	2	33
0004	Bath Light Timer	4	22	46	5.7	5.7	2	2	40
0010	Stair Light Timers	9	54	136	4.9	4.9	8	2	40
0229	Stair Light Timers	8	49	139	4.3	4.3	6	2	40
0251	Stair Light Timers	8	49	139	4.3	4.3	6	2	40
0009	Timer On Vending Machine	10	61	175	4.3	4.3	6	2	34
0227	Stair Light Timers	5	27	93	3.6	3.6	4	2	40
0228	Stair Light Timers	4	24	93	3.2	3.2	4	2	40
0250	Stair Light Timers	6	33	139	2.9	2.9	6	2	40
0105	Lamp Photocell	4	24	105	2.9	2.9	4	2	41
0004	Replace Radiator Valves	11	93	440	2.7	2.7	12	1	08
0131	Outdoor Light Photocell	7	43	210	2.5	2.5	8	2	41

TABLE 4.2 (Cont'd)

INCREMENT F:

SUMMARY OF OPERATION AND MAINTENANCE MODIFICATIONS

BLDG	CONSERVATION OPTION	MBTU/YR	$/YR	TOTAL COST	ESIR	SIR	MANHOURS	L.T.	REF.
0013	Hall Light Timers	13	76	370	2.5	2.5	16	2	40
0105	Repair Bath Rad. Valve	1	12	73	2.0	2.0	2	1	08
0226	Outdoor Light Photocell	3	16	105	1.9	1.9	4	2	41
0228	Outdoor Light Photocell	3	16	105	1.9	1.9	4	2	41
0229	Outdoor Light Photocell	3	16	105	1.9	1.9	4	2	41
0003	Outdoor Lamp Photocell	2	14	105	1.6	1.6	4	2	41
0004	Stop Heating Vestibule	1	7	73	1.3	1.3	2	1	10
0011	Stair Light Timers	1	8	136	.7	.7	8	2	40
0107	Repair Seals 3 Freezers	4	21	513	.5	.5	12	1	43
0105	Repair Freezer Seals	1	7	220	.4	.4	8	1	43

PROJECT DESCRIPTION (Cont'd)	ENERGY SAVINGS (MBTU/yr)	MATERIAL COST ($)	LABOR HOURS (Hours)
Incandescent Lighting Replacement Many of the existing incandescent lighting fixtures and lamps can be replaced with higher efficiency flourescent lighting to reduce electricity consumption.	1,127	11,300	500

4.4 Recommendations for Electrical Load Management

Management of electrical loads creates opportunities for reducing operating costs. The methods recommended do not conserve a significant amount of energy but rather control the use of electrical energy in order to take fair advantage of utility rate schedules. The recommendations are summarized below.

	Cost Savings ($/yr)	Investment ($)
1. Load Shedding A demand limiting (ripple) control system can be installed to reduce peak demand utility charges by temporarily disconnecting certain loads during peak demand periods.	$11,500	103,800
2. Use of Standby Generators If 50% of the presently installed standby generators were operated parallel with the utility for approximately four hours each day in January to lower the annual peak		

	Cost Savings ($/yr)	Investment ($)
demand, the rate paid for electrical energy throughout the year would be lowered. If policy could be changed to permit the use of generators in this manner, annual savings would be estimated to be: $23,000		
3. Power Factor Correction Carl Schurz Kaserne does not currently pay a power factor penalty and does not keep records of power factor; however, an analysis was performed for the improvement of power fctor based on a spot check performed by the utility in June 1980.	$ 2,715	9,300
4. Optimum Transformer Loading Transformer losses can be reduced by main taining transformer loading in the most economical loading range as discussed in Section 7.4 of Volume II.	$ 1,400	-

4.5 Summary of Energy and Cost Savings

Potential energy and utility cost savings for Carl Schurz Kaserne are summarized below.

	Energy Savings (MBTU/yr)	Cost Savings ($/yr)
ECIP Projects	41,081	$357,933
Specific Operation and Maintenance Recommendations	3,583	30,235
General Operation and Maintenance Recommendations	21,887	189,281
Recommendations for Load Shedding and Power Factor Correction	-	14,215
Optimum Transformer Loading	-	1,400
	TOTAL	$593,064

5.0 SPECIAL APPROACHES TO ENERGY UTILIZATION

Part of the EEA effort was directed toward special approaches to energy utilization with the goal of reducing dependency on critical fuels as well as reducing energy consumption. Renewable energy sources including solar, biomass, geothermal, wind and waste have general potential to replace petroleum fuels for space heating and hot water. For the current Carl Schurz Kaserne applications, wind energy and solar appeared to be technically feasible renewable energy sources. Other special approaches which have been successfully applied elsewhere were analyzed but found inappropriate for the specific application factors in Bremerhaven. In general, alternative sources are most attractive when replacing oil, natural gas or electric energy and are least attractive when replacing coal; DOD's push to increase coal usage makes it more difficult for these alternatives to compete.

The conclusions of the various energy utilization approaches evaluated are summarized below:

Opportunity Investigated	Conclusion
Utilization of Wind Energy	The average wind velocity in Bremerhaven is 5.05 meters/sec making wind energy potentially economical. An analysis in Section 5, Volume II shows that although technically feasible, it is not economical.
Geothermal Energy	There is no possible practical application in the Bremerhaven area.
Biomass (Fuel Derived from Plant Life)	This technology is not commercially developed and the availability of fuel stock is unreliable.
Waste-to-Energy Systems - Refuse Derived Fuel	Although refuse burning is technically feasible it is not economically attractive in Carl Schurz Kaserne.
- Biogas	Biogas is not competitive with fossil fuels and does not have a potential for utilization in Carl Schurz Kaserne.

Opportunity Investigated	Conclusion
Waste-to-Energy Systems (Cont'd) - Sewage Gas	Cost effective utilization of sewage gas at Carl Schurz Kaserne is not possible. Only when new sewage plants are constructed does the utilization of sewage gas become economically attractive.
- Pyrolysis of Municipal Refuse	This technology has not advanced far enough to be considered for commercial development.
Coal/Oil Mixtures	This technology is being developed for commercial demonstration. This fuel is not now available for commercial purchase.
Solar Energy	The most appropriate application of this proven technology at Carl Schurz Kaserne is for heating domestic water. Analysis concluded that this application was not life cycle cost effective by ECIP criteria for ten buildings having the greatest application potential.
District Heating	Utilization of municipal district heating is very common in West Germany but no systems are located near enough to the Carl Schurz Kaserne to be utilized.

EMCS applications studied for Carl Schurz Kaserne resulted in the recommendation of localized Micro EMCS in the form of building heating system controls and remote limited function EMCS for peak demand limiting. The heating system controls bring significant energy savings to be incorporated in the ECIP projects. The demand limiting EMCS reduces utility charges but does not significantly save energy; this project must be funded through sources other than ECIP.

6.0 ENERGY PLAN

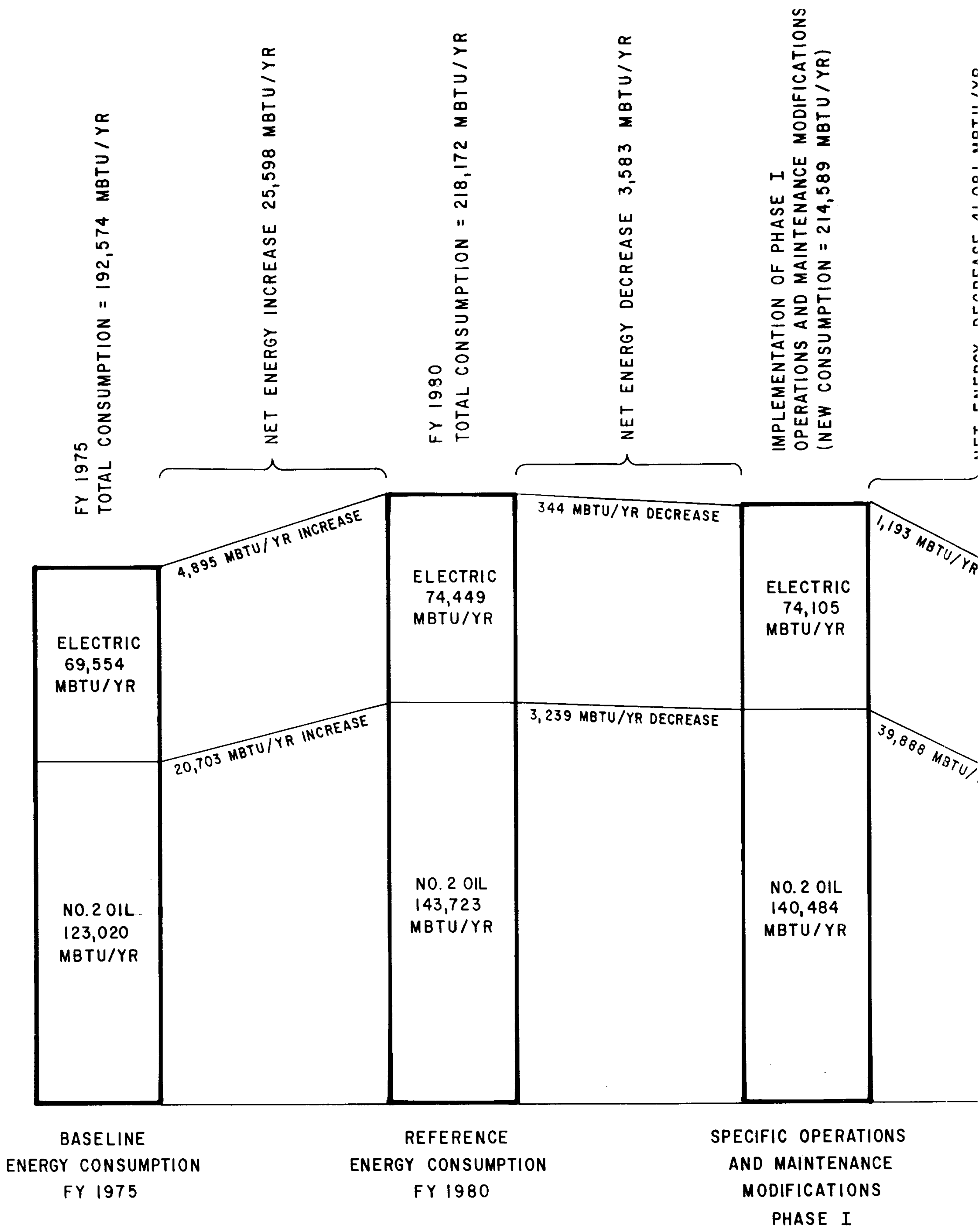
The "Basewide Energy Plan" as developed hereunder integrates ongoing energy conservation operations and maintenance activities, programmed ECIP Projects, programmed projects (which save energy) in the OMA, MMCA, MCA and FH categories and EEAP Study recommendations in both the operations and maintenance category and the capital (ECIP) improvement category.

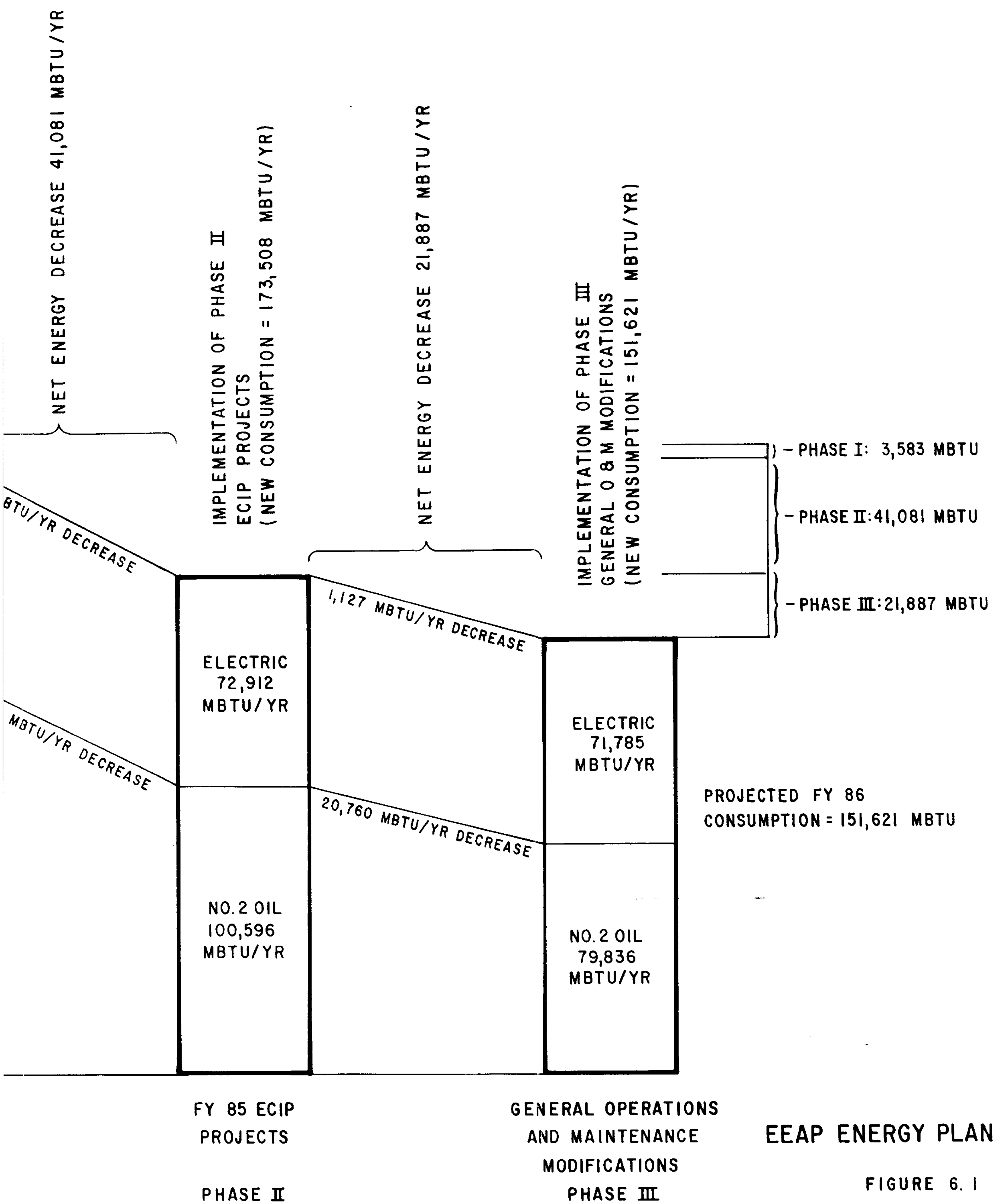
Figure 6.1 graphically depicts the implementation of the following energy plan. Figure 6.2 shows the energy consumption/energy savings profile as a function of time. The baseline data is as follows:

FY 75 BASELINE ENERGY CONSUMPTION	: 192,574 MBTU/YR
CRITICAL FUEL OIL CONSUMPTION	: 123,020 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 139.04

The reference year for this study is FY 80. The available data indicates that community energy consumption increased over FY 75 levels:

FY 80 REFERENCE ENERGY CONSUMPTION	: 218,172 MBTU/YR
% REDUCTION FROM BASELINE	: -13.3%
FY 80 CRITICAL FUEL OIL CONSUMPTION	: 143,723 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 157.5


FY 1975
TOTAL CONSUMPTION = 192,574 MBTU/YR
NET ENERGY INCREASE 25,598 MBTU/YR
FY 1980
TOTAL CONSUMPTION = 218,172 MBTU/YR
NET ENERGY DECREASE 3,583 MBTU/YR
IMPLEMENTATION OF PHASE I
OPERATIONS AND MAINTENANCE MODIFICATIONS
(NEW CONSUMPTION = 214,589 MBTU/YR)
4,895 MBTU/YR INCREASE
344 MBTU/YR DECREASE
ELECTRIC
69,554
MBTU/YR
ELECTRIC
74,449
MBTU/YR
ELECTRIC
74,105
MBTU/YR
20,703 MBTU/YR INCREASE
3,239 MBTU/YR DECREASE
NO. 2 OIL
123,020
MBTU/YR
NO. 2 OIL
143,723
MBTU/YR
NO. 2 OIL
140,484
MBTU/YR
BASELINE
ENERGY CONSUMPTION
FY 1975
REFERENCE
ENERGY CONSUMPTION
FY 1980
SPECIFIC OPERATIONS
AND MAINTENANCE
MODIFICATIONS
PHASE I



EEAP ENERGY PLAN

FIGURE 6.1

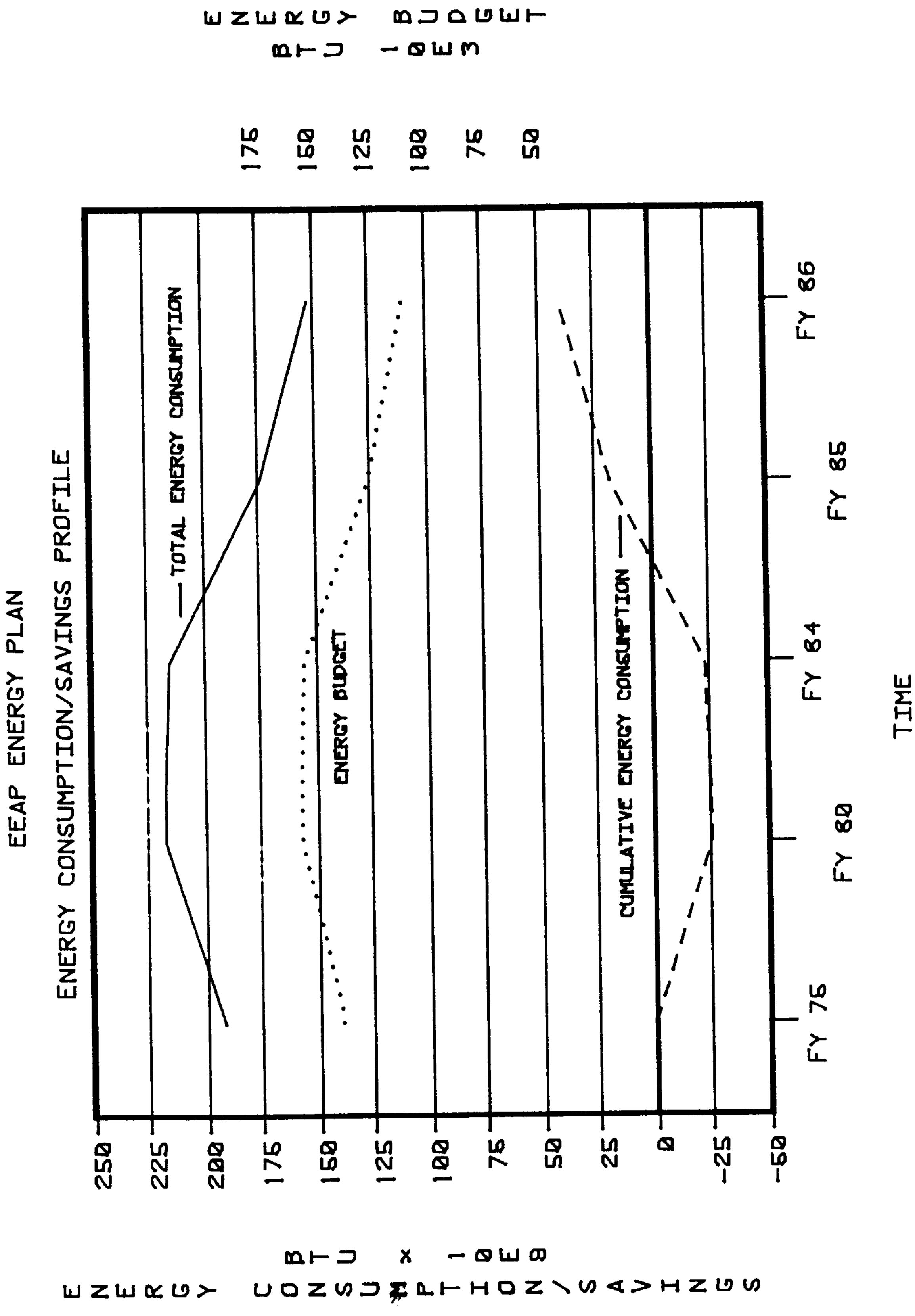

EEAP ENERGY PLAN
ENERGY CONSUMPTION/SAVINGS PROFILE
TOTAL ENERGY CONSUMPTION
ENERGY BUDGET
CUMULATIVE ENERGY CONSUMPTION
ENERGY BUDGET
BTU 1ØE3
175
150
125
100
75
50
250
225
200
175
150
125
100
75
50
25
Ø
-25
-50
ENERGY CONSUMPTION/SAVINGS
BTU x 1ØE9
FY 76
FY 80
FY 84
FY 85
FY 86
TIME

FIGURE 6.2

Phase I of the energy plan is the implementation of specific operations and maintenance type modifications. Using in-house labor these modifications can be made relatively quickly and can be done inexpensively; collectively, they will yield a payback of less than three months and reduce the total annual energy consumption as follows:

Upon Completion of Phase I:

TOTAL ENERGY CONSUMPTION	: 214,589 MBTU/YR
% REDUCTION (CUMULATIVE) FROM BASELINE	: -11.4%
CRITICAL FUEL OIL CONSUMPTION	: 140,484 MBTU/YR
ENERGY BUDGET KBTU/SF - YR (10^3)	: 154.9

Phase II of the energy plan is a part of the ongoing energy conservation efforts of Norddeutschland Military Community. The anticipated savings for this phase are derived from those projects which have already been programmed by the community and are in various stages of approval, design or construction. A savings projection, for those projects listed in Section 3, is not available.

Phase II also includes the implementation of energy conservation measures recommended herein and chosen by the community for implementation. Project documentation has already been developed for Phase II projects and been sent forward for approval as FY 85 projects. The savings projection for this phase is 41,081 MBTU/yr. The reduction of total annual energy consumption is as follows:

Upon Completion of Phase II :

TOTAL ENERGY CONSUMPTION	: 173,508 MBTU/YR
% REDUCTION (CUMULATIVE) FROM BASELINE	: 10.2%
CRITICAL FUEL OIL CONSUMPTION	: 100,596 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 125.3

Phase III of the energy plan is the implementation of general operations and maintenance type measures. Most of these measures have not been quantified because they are either accomplished during the normal course of maintenance, are maintenance activities necessary to maintain level of savings achieved through other energy savings measures or are monitoring activities which are necessary in order to achieve success in any energy conservation plan. These general operations and maintenance type measures are discussed in Sections 6.3 and 6.4 of Volume II. The savings projection for this phase is 21,887 MBTU/yr. The reduction of total annual energy consumption is as follows:

Upon Completion of Phase III:

TOTAL ENERGY CONSUMPTION	: 151,113 MBTU/YR
% REDUCTION (CUMULATIVE) FROM BASELINE	: 21.5%
CRITICAL FUEL OIL CONSUMPTION	: 79,836 MBTU/YR
ENERGY BUDGET KBTU/SF - YR	: 109.1

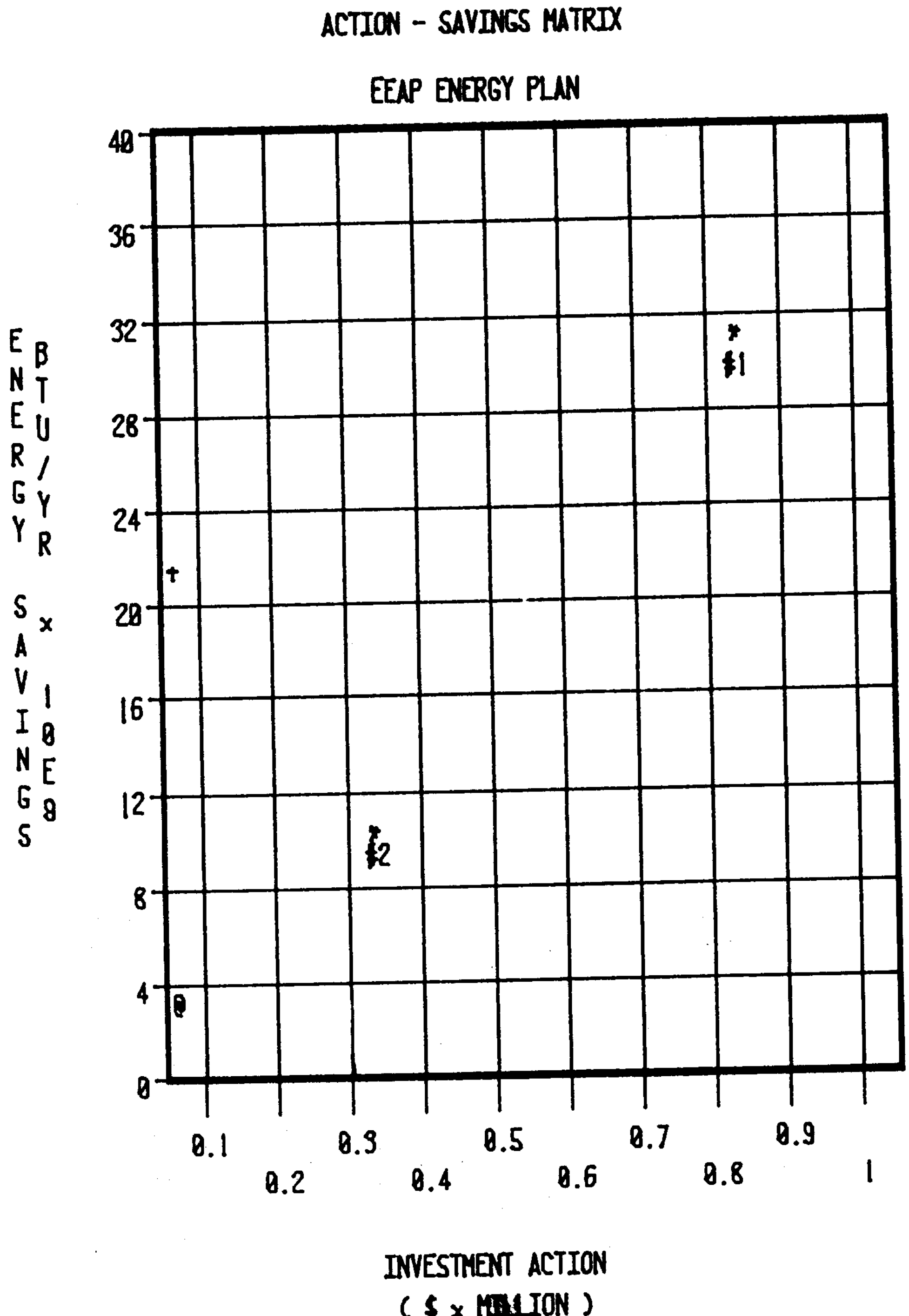
Implementation of this energy conservation plan will result in several coincident energy reductions on the same buildings. Care was taken so as not to duplicate energy savings within the secondary systems or between the primary and secondary systems; therefore, in view of the conservative approach taken in energy savings calculations, the predicted savings are achievable. However, a program for monitoring the progress of the energy plan and gauging the savings is of the utmost importance; this is necessary to identify problems in meeting goals as early on in the program as is feasible.

Figure 6.3 presents a matrix of the energy conservation projects versus savings and costs.

6.1 Army Facilities Energy Plan Goals

The above described plan was developed to reduce energy consumption at Carl Schurz Kaserne in accordance with the goals of the Army Facilities Energy Plan.

A comparison of the goals of the Army Facilities Energy Plan and the findings and results of this study is made in Table 6.4.



LEGEND

@ SPECIFIC OPERATIONS AND MAINTENANCE ECO'S

* ECIP DD FORMS 1391: #1:ECIP WEATHERIZATION
#2:ECIP ENERGY CONSERVATION IMPROVEMENTS

+ GENERAL OPERATIONS AND MAINTENANCE ECO'S

FIGURE 6.3

TABLE 6.4

	ARMY FACILITIES ENERGY PLAN	EEAP ENERGY PLAN
YEAR 1985 GOALS	a. Reduce Army installation and activity energy consumption by 25% of that consumed in FY 75 as the base year.	a. Energy consumption reductions to date in combination with recommended operations and maintenance modifications and recommended ECIP projects will serve to reduce annual consumption by approximately 22%.
	b. Reduce average annual energy consumption per gross square foot of floor area by 20% in existing facilities compared to FY 75 as the base year. At least 12% of the energy reduction in existing buildings shall be accomplished through energy conservation projects under the Energy Conservation Investment Program (ECIP).	b. The average annual energy consumption will be reduced from 139,040 BTU/SF - YR to 109,100 BTU/SF - YR upon complete implementation of the plan; this is a 21.5% reduction. The EEAP ECIP projects will save an estimated 21% of FY 75 consumption of existing facilities; this coupled with community-programmed ECIP projects should meet the goal.
	c. Reduced average annual energy consumption per gross square foot of floor area by 45% in new buildings compared to FY 75 as the base year.	c. This shall be accomplished by proper review and monitoring throughout the design phase.
	d. Reduce dependence on critical fuels:	d.
	1. Obtain at least 10% of total Army installation energy from coal, coal gasification, solid waste, refuse derived fuel and biomass.	1. None of the existing facilities are currently heated by coal; this goal can be satisfed by the conversion of Central Heating Plant 110 to coal firing as discussed in Section 4.
	2. Equip all natural gas only heating units and plants over 5 MEGA BTU per hour output with the capability to use oil or other alternate fuels.	2. Carl Schurz Kaserne does not have any natural gas only heating units over 5 MEGA BTU.
	3. To have on hand at the beginning of each heating season a 30-day fuel supply for all oil only, oil - natural gas, and coal heating units over 5 MEGA BTU per hour output based upon the coldest month recorded and in a mobilization condition.	3. This shall be accomplished through implementation of proper procurement regulations.
	4. Obtain 1% of total Army installation energy by solar means.	4. Based on analysis of solar applications for Carl Schurz Kaserne, solar energy projects should be concentrated in other geographical areas where the project economics are expected to be very attractive.
	5. Restrict the use of electric resistance heating to those applications prescribed in ETL 1110-3-254.	5. Survey data did not indicate that electric resistance heating was being used in Carl Schurz Kaserne. In facilities where building heating control systems had been installed, use of portable electric heaters in barracks was reported. This illustrates the need to institute tight controls over unauthorized use of private electric resistance heaters.
	6. Require the energy efficiency ratios of new windows air conditioning units to be 8.5 or greater for 120 volt units and 8.0 or greater for 230 volt units.	6. Air conditioning units, for comfort cooling, are not installed at Carl Schurz Kaserne. Recommendations for purchase of energy conservation design options on replacement equipment are included in Section 6 of Volume II.

TABLE 6.4 (Cont'd)

	ARMY FACILITIES ENERGY PLAN	EEAP ENERGY PLAN
YEAR 2000 GOALS	a. Reduce Army installation and activity energy consumption by 50% of that consumed in FY75.	a. This goal will be difficult to attain. By implementing the EEAP Plan, the existing structures and utility systems will have been modified with those conservation measures now practical; this will reduce FY75 energy consumption by 22%. Through proper maintenance, these savings should be maintained through 2000. The additional 28% savings will have to be achieved by the construction of new more efficient facilities, replacement of inefficient equipment through attrition and general maintenance and operations measures (not quantified) discussed in Volume II; heating plants should be the primary targets for replacement of existing equipment with higher efficiency equipment.
	b. Reduce dependence on critical fuels. 1. Eliminate use of natural gas. 2. Reduce the use of petroleum fuels in installations operations by 75%.	b. These goals can be met through conventional technology. The EEAP Plan shows a reduction of 35% in critical fuels. The most logical approach to further reduction in critical fuels would be repair by replacement and consolidation of oil-fired heating plants (oil to coal conversion).